shown in elevation in FIGS. **5**C and **5**D. In FIG. **5**C, a first patch **535** is embroidered into the matrix of fabric **500** using conductive thread. A face of patch **535** is covered by a patch **537** of a non-conductive, dielectric material, such as a layer of fabric, an applied layer of adhesive, etc. A second conductive patch, preferably coextensive in area with patch **535**, is disposed over non-conductive patch **537**, thereby forming a capacitor. A conductive contact lead **542**, which may simply be the end of the conductive thread making up patch **540**, is taken from the patch and, if desired, stitched into fabric **500**. A similar lead **544** is taken from patch **535**.

Once again, one or both of patches **535**, **540** may be formed from an already-woven conductive material attached to panel **500**, instead of being built up on that panel by embroidery.

In the alternative shown in FIG. **5**D, a pair of patches **550**, **552** are embroidered into (or attached onto, or woven into) separate panels of fabric **500***a*, **500***b*. The panels are separated by an intervening dielectric layer **554**, which may be simply another layer of fabric **500**, or a more traditional dielectric material such as plastic. When the layers are combined into a composite construction **555**, patches **550**, **552** overlie each other across layer **554**. A contact lead **560** drawn from patch **552** can be brought through layer **550** and into layer **500***a*, thereby allowing both capacitor leads **560**, **562** to reside on the same fabric panel **500***a* for connection to other components. Using this approach, it is possible to conveniently obtain relatively large capacitor "plate" areas; for example, panels **500***a*, **500***b* can be concentric cylindrical sleeves, with patches **550**, **552** radially aligned and extending around the entire circumferences.

An inductor may be formed as shown in FIG. **6**A. A non-conductive fabric matrix **600** has a conductive (and, desirably, magnetically permeable) fiber or thread **605** stitched into a spiral pattern **607**. The ends of fiber **605** are connected to other electronic circuitry on matrix **600**, or to external circuitry using conductive fasteners as described above. To avoid resistive effects (which can, for example, reduce the Q-factor of the inductor), it is preferred to use fiber of low resistivity, such as the foil-wrapped fibers used in organza fabrics or a conductive thread having a high metal content. It may also be preferred that matrix have enhanced magnetic permeability (although not electrical conductivity) in the region of spiral **607** in order to concentrate the magnetic field within the region of the inductor.

Greater inductance can be obtained by expanding the size of spiral pattern **607**, or by stacking multiple layers of fabric **600***a*, **600***b*, **600***c*, each with its own spiral pattern **607***a*, **607***b*, **607***c*, as shown in FIG. **6**B. To maintain proper current flow through each spiral pattern, the layers **600***a*, **600***b*, **600***c* are isolated from one another, e.g., using intervening fabric panels (not shown). This design will, however, introduce capacitance, and the component will behave as an LC circuit rather than as an inductor.

In another embodiment, illustrated in FIG. **6**C, the fabric panel **600** is formed into a cylindrical sleeve, and the spiral pattern **615** formed by winding a conductive fiber around the circumference to form the inductor structure **620**. For example, panel **600** may in this case be a cuff or a shirtsleeve segment. Any of the foregoing inductor designs can be used in pairs or groups, disposed closely enough to each other so the coils magnetically couple, to determine the orientation of one or more of the inductors; this permits, for example, construction of fabrics that "know" their own orientation.

Such an approach is shown in FIG. **6**C, where inductor **620** is connected to a sensing circuit **625** that measures the current produced in inductor **620** as a result of magnetic coupling to another inductor **630**, which is energized by a control logic circuit **635**. The orientation and proximity of inductor **630** with respect to inductor **620** determines the degree of magnetic coupling, and hence the induced current level, in the latter inductor. This current level may be provided to control logic **635**, as indicated in the figure, for use in connection with a desired application embodied in the control logic. Multiple energized coils with known orientations and positions, and magnetically coupled to sensing coil **620**, can be used to determine the orientation of coil **620** with precision.

The inductors described above may be used, e.g., as coil antennas for reception and/or broadcast. It should be noted, however, that other types of antennas can also be realized with the invention. For example, connecting a voltage source across an anisotropically or isotropically conductive fabric exhibiting some resistivity creates a dipole that can be used as an electrostatic antenna to sense the magnitude and orientation of an electric field gradient.

A transformer may be formed as shown in FIGS. **7**A, **7**B. In FIG. **7**A, a pair of fabric panels **700***a*, **700***b* each has a conductive, magnetically permeable fiber or thread **705***a*, **705***b* stitched into a spiral pattern **707***a*, **707***b*. The spirals each connect to other fabric-borne circuitry, or terminate in a pair of conductive fasteners for external connection. The panels **700***a*, **700***b* are spaced closely enough (and, desirably, are oriented parallel) to permit magnetic coupling between the spiral patterns **707***a*, **707***b*. Energizing one of the spirals induces a current in the other spiral, the induced voltage being proportional to the ratio of turns in the two spirals. An intervening, non-conductive fabric panel **710** may be introduced between panels **700***a*, **700***b* to maintain separation therebetween, or the spiral patterns **707***a*, **707***b* may be isolated from each other by disposing them on opposite sides of the respective fabric panels without penetration through the fabric.

Alternatively, the panels **700***a*, **700***b* can be formed into concentric cylindrical sleeves, with spirals **707***a*, **707***b* wound around the circumferences and radially aligned with each other during use. In this case, panels **700***a*, **700***b* may, for example, be part of the sleeves of a jacket and a shirt worn thereunder.

Resistors are straightforwardly formed simply by using conductive thread or fabric having a desired degree of resistivity. Resistive networks can be formed using threads or fabrics of varying resistivities.

It will therefore be seen that the foregoing represents a new and highly versatile approach to the construction of electrical circuits using fabrics both as substrates and to form electrical components. The terms and expressions employed herein are used as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed.

What is claimed is:

1. A textile fabric having electrical functionality, the textile fabric comprising:

a. a first series of parallel fibers, said fibers being electrically non-conductive;

b. interwoven therewith in a perpendicular direction thereto, a second series of parallel fibers, at least some of said fibers being electrically conductive, said first series and second series of parallel fibers forming a matrix;